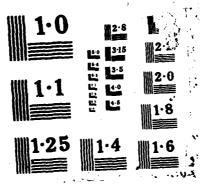AD-A192 160   TO RELATE MEASUREMENTS OF GRAVITY AND GEOID ANOMALIES   1/1
              OVER THE OCEANS TO..(U) CORNELL UNIV ITHACA NY DEPT OF
              GEOLOGICAL SCIENCES   D L TURCOTTE 1987 N00014-85-K-0063
UNCLASSIFIED   F/G 8/5   NL

Final Technical Report

Title: To Relate Measurements of Gravity and Geoid
                Anomalies Over the Oceans to Near Surface
                Density Distributions
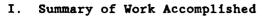
Principal
Investigator: Donald L. Turcotte

                Department of Geological Sciences
                Cornell University, Ithaca, New York   14853-1504
                (607) 255-7282

I.   Summary of Work Accomplished

One of the principal objectives of the research is to understand the relationship between the measured geoid and gravity anomalies and bathymetric anomalies. The principal approach was to use the Haxby-Ockendon-Turcotte (HOT) geoid formula to relate the oceanic geoid to the structure of the oceanic lithosphere. Significant progress has been made on correlating geoid spectra with bathymetry spectra. Various models for relating bathymetry to geoid have been applied to this problem from uncompensated topography to partial compensation at a variety of depths. Two lengthy papers summarizing a wide variety of results were published (1,2).

A second objective of our research was to develop a fundamental understanding of the morphology of the sea floor. This research followed two lines, the first used synthetic stratigraphy in order to understand how continental margins evolved and the second used the fractal character of the spectrum of oceanic bathymetry and oceanic geoid in order to better understand fundamental origins of bathymetry and geoid anomalies.

A series of papers on the morphology of sedimentary structures in the oceans have been published. These include our basic outline of synthetic stratigraphy on passive continental margins (3), our studies on the formation of coral reef terraces (4), the sedimentation associated with the erosion of an ocean island (5), and our studies of prograding river deltas (6).

We have carried out a variety of studies concerning the fractal nature of the sea floor. Spectral analyses of bathymetry generally yield a power law dependence on wave number; this is associated with fractal behavior. The slope gives the fractal dimension and the amplitude is a measure of roughness. In our studies of digitized bathymetry (SYNBAPS) and digitized geoid, we have obtained maps of fractal dimension and roughness amplitude. The roughness amplitude has considerable variations and is a promising parameter for the quantitative classification of sea floor morphology.

Significant variations in the fractal dimension are also found. The mean fractal dimension for 2-D Fourier spectral studies is near D = 2.1, for 1-D Fourier spectral studies the mean fractal dimension is near D = 1.5. close to the Brown noise value. Both of these values are consistent with results obtained previously. It is concluded that 1-D spectral studies do not represent the true fractal dimension of bathymetry. This result is confirmed in synthetically derived images. This work has been presented (7) and is being written up.

II. Index of Publications

1. D.L. Turcotte and R.A. Harris, Relationship between the oceanic geoid and the structure of the oceanic lithosphere, Marine Geophys. Res. 6, 177-190 (1984).

2. D.L. Turcotte, Properties of the lithosphere and asthenosphere deduced from geoid observations, in Space Geodesy and Geodynamics, A.J. Anderson and A. Cazenave, eds., pp. 451-475, Academic Press, London, 1986.

3. D.L. Turcotte and P.M. Kenyon, Synthetic passive margin stratigraphy, Am. Assoc. Petrol. Geol. Bull., 68, 768 (1984).

4. D.L. Turcotte and M.J. Bernthal, Synthetic coral-reef terraces and variations of Quaternary sea level, Earth Planet. Sci. Let., 70, 121 (1984).

5. I. Moretti and D.L. Turcotte, A model for erosion, sedimentation and flexure with applications to New Caledonia, J. Geodynamics, 3, 155 (1985).

6. P.M. Kenyon and D.L. Turcotte, Morphology of a delta prograding by bulk sediment transport, Geol. Soc. Am. Bull., 96, 1457 (1985).

7. J. Huang, D.L. Turcotte and R.F. Smalley, Fractal mapping of bathymetry and geoid. Presented at the 1987 Spring Meeting of the American Geophysical Union, Baltimore, Maryland. May 18-21, 1987. Trans. Am. Geophys. Un. 68, 423 (1987).

END
DATE
FILMED
5-88
DTIC